DRACO – Flight Demonstration Towards an Operational Nuclear Thermal Propulsion System

NASA Space Nuclear Propulsion

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AIAA SciTech 2024

NASA Space Nuclear Propulsion (SNP)

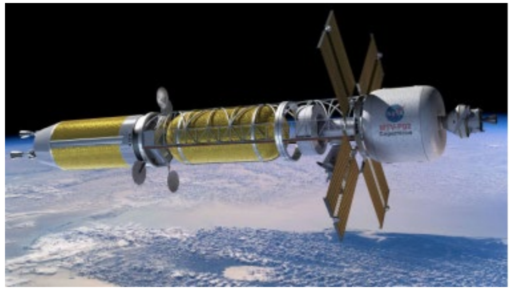
Overview

Vision

Robust and enduring access to destinations throughout the solar system

Mission

Revolutionize space travel through the development *and demonstration* of robust and high performing nuclear propulsion systems

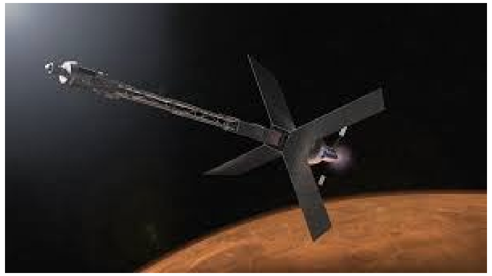


Nuclear Thermal Propulsion (NTP)

Fission is a thermal power source, the reactor acts as a heat exchanger for high efficiency, high thrust applications (long or short duration missions)

Nuclear Electric Propulsion (NEP)

Fission is a thermal power source which is converted to electricity to power electric propulsion thrusters to enable fast transit to far away destinations

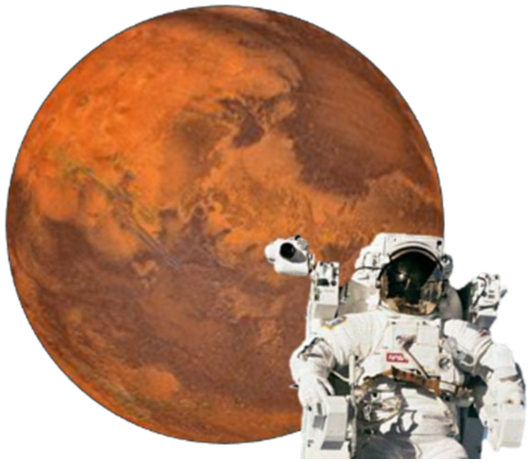


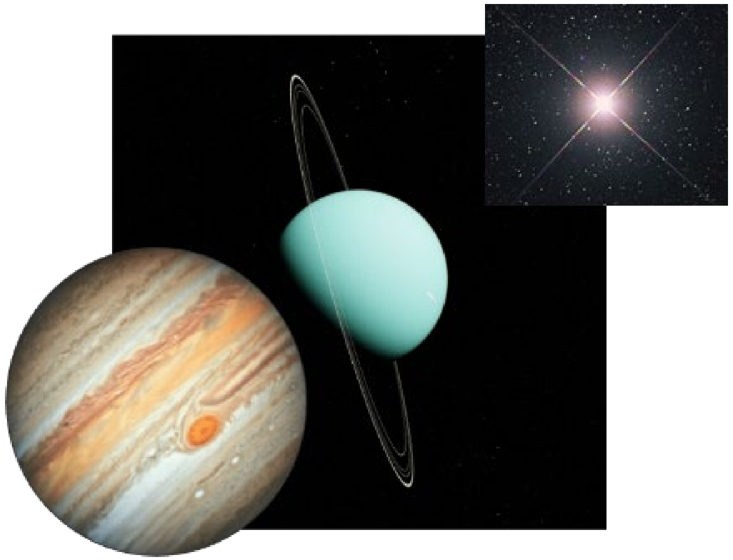
NASA Space Nuclear Propulsion Program Goals

1. Develop nuclear propulsion capabilities that can be directly leveraged or readily evolved to meet the Agency’s future missions, including human exploration of Mars and deep space science

2. Mature the enabling technologies and demonstrate the engineering performance of integrated nuclear propulsion systems in relevant operational environments

3. Collaborate with other government organizations, industry, and academia to support the development and commercial infusion of nuclear propulsion capabilities and supporting infrastructure





Space Nuclear Propulsion Mission Spaces

Orbital Transfers, Loitering, and Maneuvering

Cis-Lunar Maneuvering and Transportation

Deep Space Exploration and Science

Mars Cargo and Crew Transit

DRACO Flight Demonstrator Background

DARPA/NASA Partnership

DRACO Objective:

Demonstrate a high-assay low enriched uranium (HALEU) Nuclear Thermal Rocket Engine in space in FY27

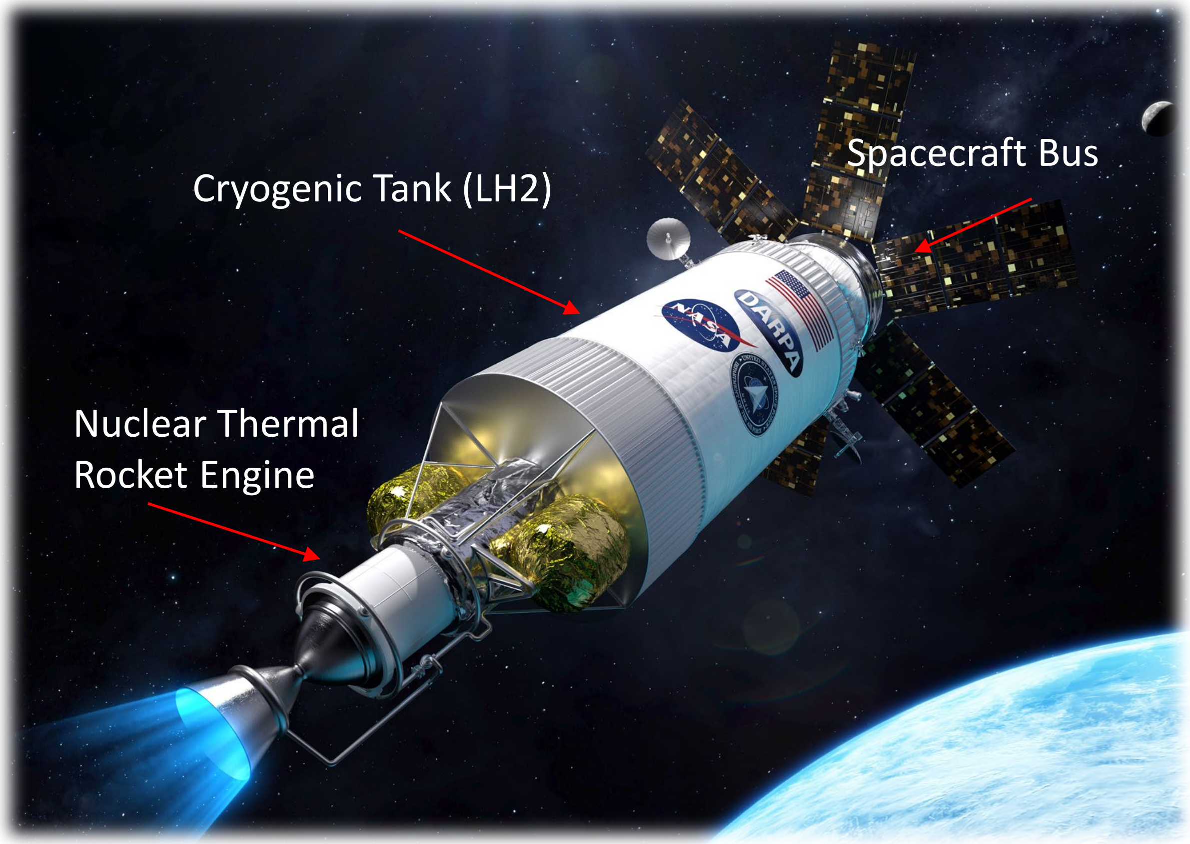
DRACO program is a partnership between NASA and DARPA to design, build, launch, and demonstrate the nation's first in-space Nuclear Thermal Rocket Engine (NTRE)

NASA responsible for managing the design, development, fabrication, testing of the NTRE

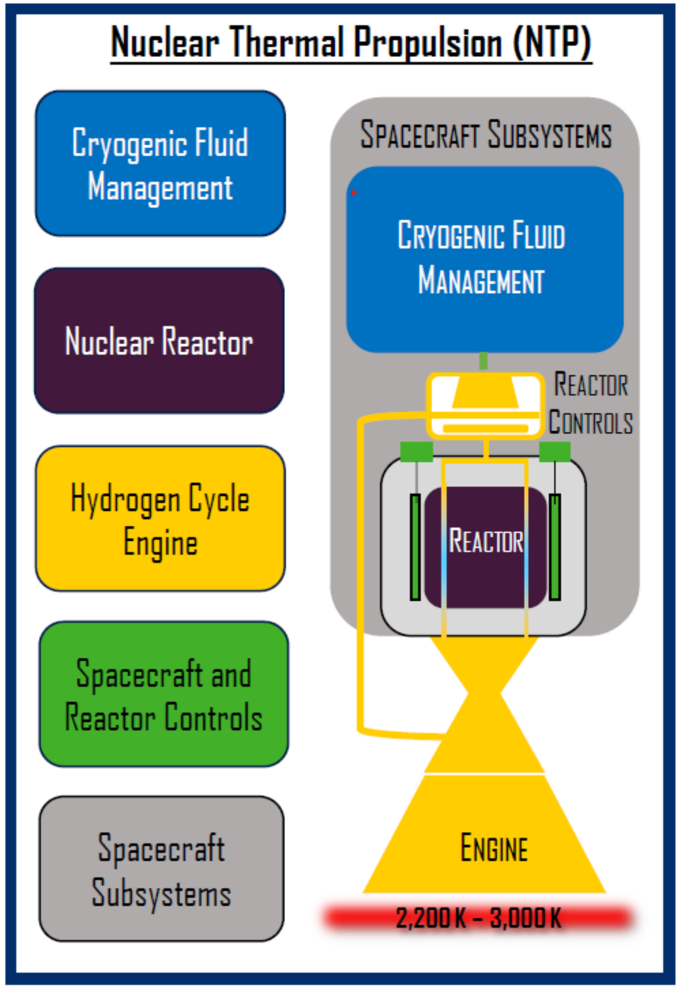
DARPA responsible for managing the design and development of the integrated flight vehicle, in-space flight operations, and all nuclear launch safety and approval processes

US Space Force procuring the Vulcan/Centaur for March 2027 Launch as part of FY24 two-year task order

Flight System comprised of 3 primary modules



Benefits of an early Flight Demonstration



- Pathfinder for interagency regulatory basis for launching and operating a fission-based systems in space
- An informed understanding of the technology gaps that need to be addressed to develop future operational flight systems

Safe end-of-life disposal

On-orbit demonstration of fission Reactor, NTRE, and generation of data that's key to assessing function and performance

NTRE Launch and Deployment

Integration of NTRE into X-NTRV demonstration vehicle

Perform integrated assembly and check out of NTRE

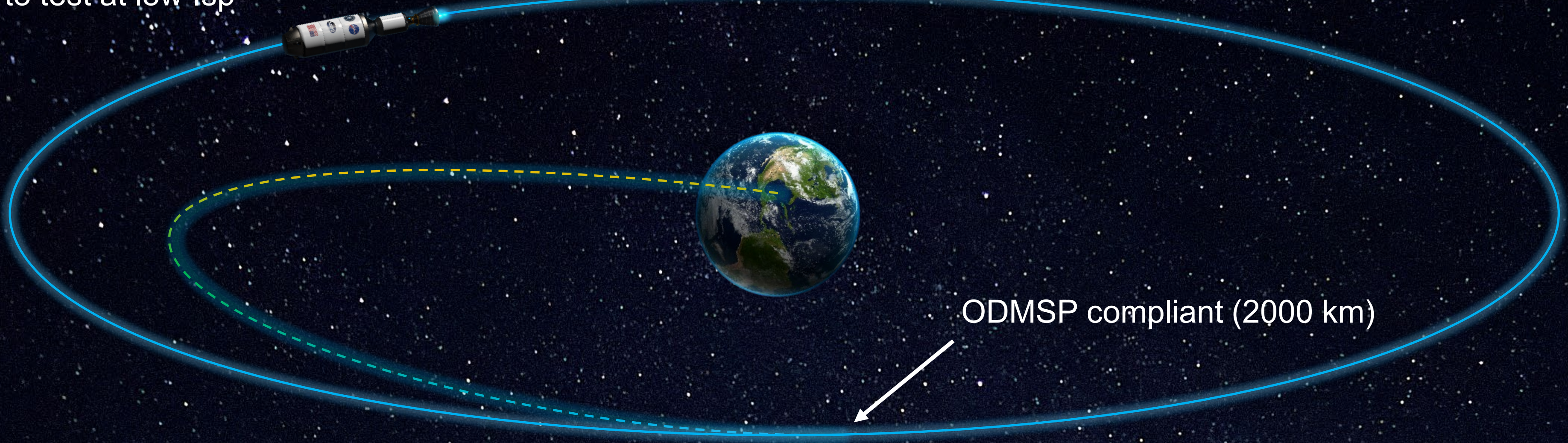
Perform engineering assessment of NTRE under launch and operational conditions

Design and build a flight-capable HALEU fueled Fission Reactor and NTRE

Draco Mission Overview

DRACO Vehicle
- Low thrust for demo (preserves LH2)
- Capable of high Isp but allowed to test at low Isp

Nuclear Launch Safety
- DRACO vehicle is the launch vehicle payload
- Reactor includes inhibits to prevent turning on reactor
- Reactor activated after successful orbit insertion



Objective of mission is to collect data on novel HALEU NTR behavior

Engine Extensibility

DRACO Flight Demonstrator

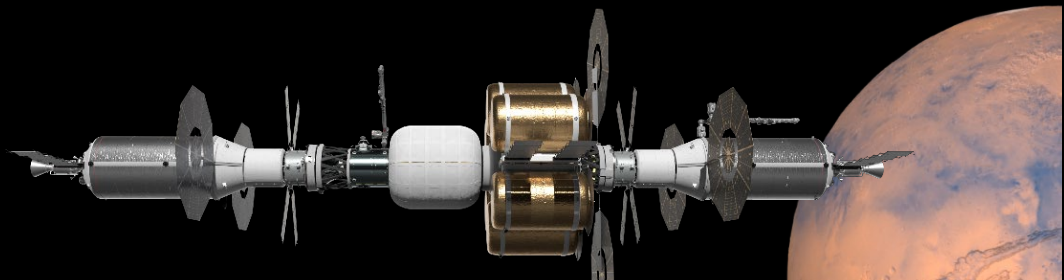
High Assay Low Enriched Uranium (HALEU) fuel

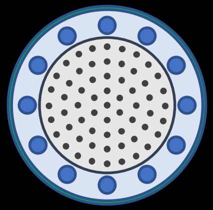
Modular core design scalable to higher thrust for Mars

Reactor core operating temperature >2700K

4+ hour engine life with repeatable starts and stops

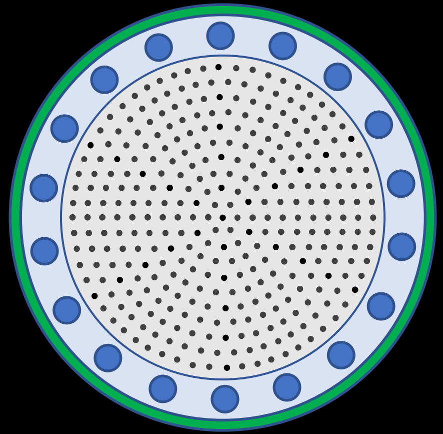
Mission duration limited by cryogenic propellent supply



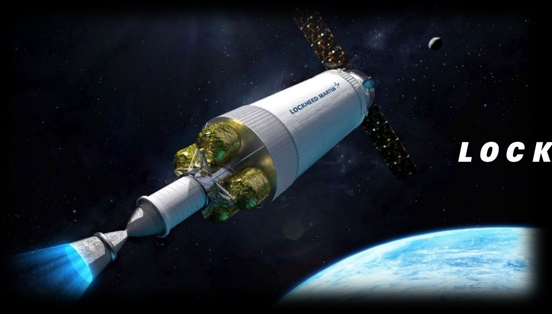


Extensibility

- Core power & size increases by adding fuel elements; fuel element & moderator block design remains the same
- Increase number of control drums; control drum design remains the same



Demonstration Reactor



LOCKHEED MARTIN

BWXT
BWX Technologies, Inc.

Mars Mission Reactor

Human Lunar Lander/Mars Transportation Study (2023)

Fuel: High Assay Low Enriched Uranium (HALEU)

Thrust per engine: 15000-25000 lbf

Chamber Temperature: 2700-2800K

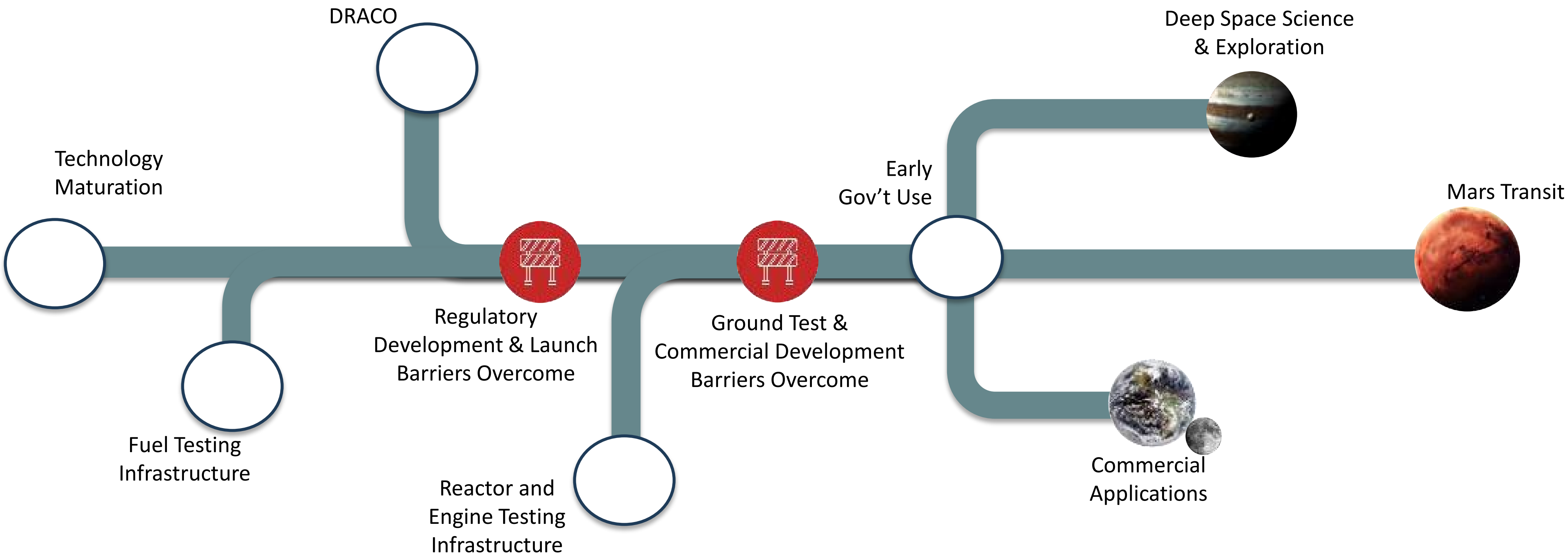
Engine Life: 4 hrs at rated thrust performance

Cryo Management: Active, Near-Zero Boiloff

Infusion within Nuclear Propulsion Development

- Pathfinder for developing regulatory basis for launching and operating fission-based systems
  - Benefits NTP, NEP, Surface Power, and Commercial Enterprises

- DRACO and 'Early Gov't Use' programs move technology across commercial and political barriers required to gain support for future test infrastructure and development investments



Questions